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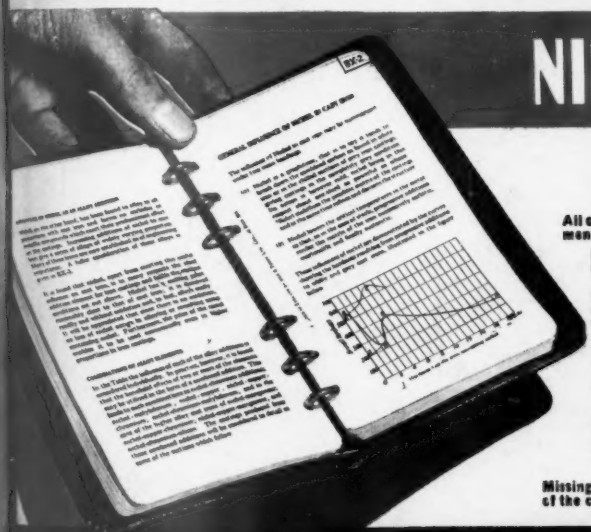

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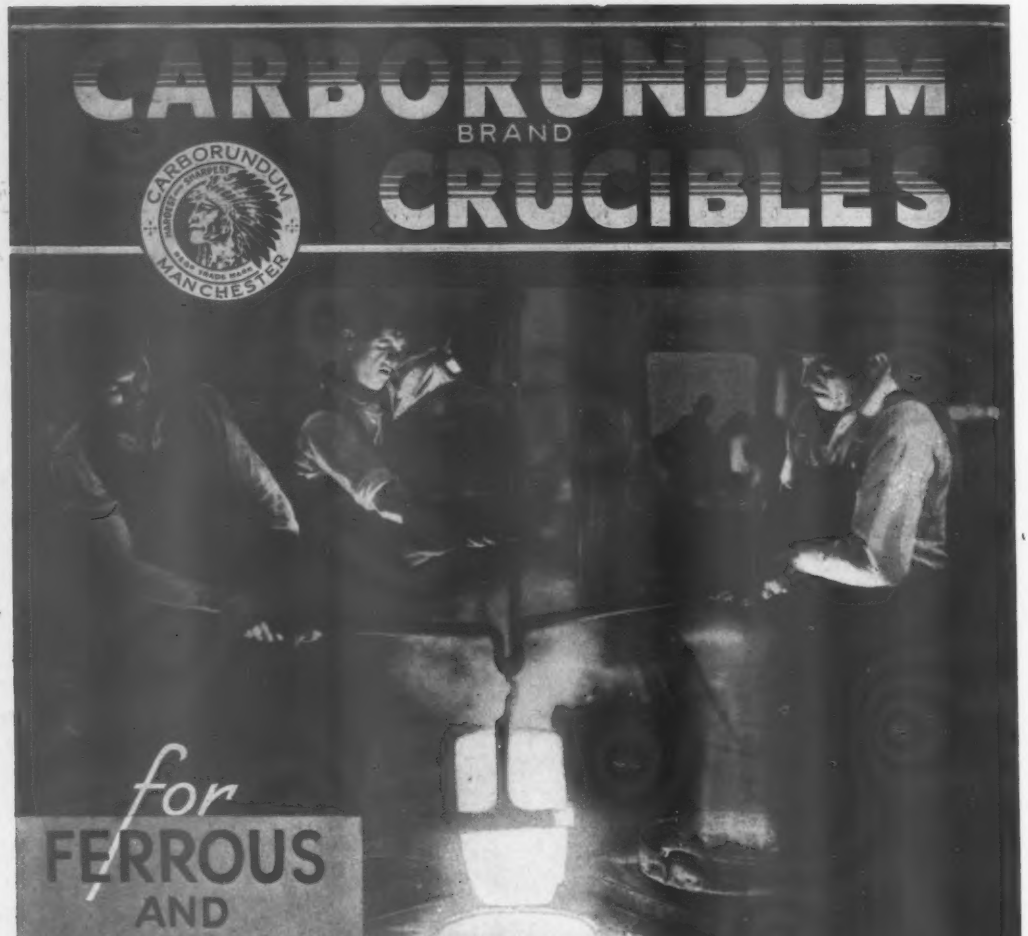

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FOUNDRY TRADE JOURNAL
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Immobilising the Immobile

Because of the technical character of their calling, foundrymen are often asked by the layman as to whether the large scale of bombing of German industries has any material effect on munitions production. The query is usually qualified by the assertion that the Germans have naturally removed all their critical plants well beyond the range of our bombers. Obviously, some efforts will have been made in this direction, but the fact that the coal and iron-ore fields are located in Western Germany, Luxembourg and North-Eastern France and are immobile makes the Ruhr the natural position for an iron- and steel-making centre. Since the birth of the metallurgical industries, it has attracted and trained the necessary skilled men for their conduct at a high technical efficiency. Around these basic industries time and experience have created a host of ancillary and secondary manufacturing activities, such as electrical and gas grids, and roll and ingot foundries, so as to realise a well-balanced industrial area. The first result of bombing is to throw the area out of balance, for the destruction of a primary producer creates shortages in the finishing shops and damage done to the latter creates a bottleneck in the former. The destruction of a main, in cases where reliance is placed on water cooling, can do damage of a serious character which would not be shown up in aerial photographs. The removal of plant to other areas is not, as technicians well know, the mere loading into trucks, transporting and delivering on the new site. In the case of a modern foundry, for example, the actual shops would require some three to five thousand tons of ironwork, 20 to 50 miles of electric wiring, anything up to half a mile of compressed-air mains, and a few thousand tons of concrete. Moreover, accommodation has to be provided for the workers in these new factories, and those who have seen the construction of industrial sites in this country must realise the immensity of these tasks. Another factor not usually appreciated is the strain placed on the non-armament factories by intensive bombing raids. People require new clothing and household furnishings, and these have to be supplied at a time when all commodities and the labour for making them are in short supply. A main feature, however, and one which is difficult of assessment, is the destruction of key industries, shops, and plant. Hits on a transformer house, a pattern-shop or stores, a compressor plant, or a tool room, do as much to shut down a complete plant as a series of bombs on a works. On the psychological side, it is well known that the inevitable destruction of workmen's homes and shopping centres has a profound influence on production, as worry about domestic affairs impairs industrial efficiency. The Germans started this phase of total warfare, showed up to some measure its potentialities, and now are squirming because of its reactions on their own war effort. We wish the B.B.C. would broadcast some of the German emissions sent out during the London "Blitz," especially the apparently popular marching song, "Bomben über London." To-day it is about as popular in the Reich as is our 1939 ditty about the Siegfried line. The latter has a better chance of a successful revival than the former! The technician is probably just as well informed as the military experts to evaluate the worth of large-scale raids on industrial areas, as each one knows how vitally the stability and usefulness of his own plant depends on one or a few quite small items, and he can be of service in creating well-informed opinion amongst the "men in the street."

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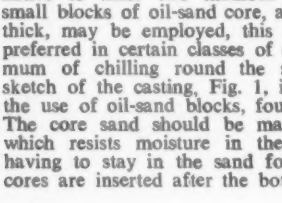
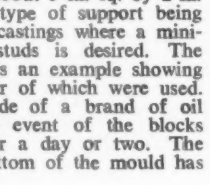
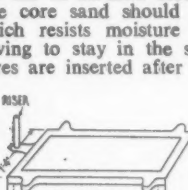
CORE BLOCKS FOR STUDS TO STAND ON

By "W. G."

For the supporting of light cores on the bottom of moulds studs are sometimes used. Bolts, with their heads level with the mould face, are bedded in the sand and in some cases cast-iron pyramids are driven firmly in the mould for the studs to rest on. Alternative to these two methods as supporting media, small blocks of oil-sand core, about 3 in. sq. by 2 in. thick, may be employed, this type of support being preferred in certain classes of castings where a minimum of chilling round the studs is desired. The sketch of the casting, Fig. 1, is an example showing the use of oil-sand blocks, four of which were used. The core sand should be made of a brand of oil which resists moisture in the event of the blocks having to stay in the sand for a day or two. The cores are inserted after the bottom of the mould has







been prepared prior to replacing the pattern for the purpose of ramming up. A space the size of the core block is cut out of the mould face about ¼ in. deep and the block of oil sand placed in and knocked down level with the face. A piece of wood is placed on top of the core for this operation to prevent the core from being marked. Fig. 2 shows floor of the mould, with blocks set on which rest ¾-in. studs ready to receive the bottom or tank core. It is important to remember that the core blocks must be firmly bedded in the mould so they will not sink when receiving the weight of the two cores, which in this case weigh 1¼ cwts. It will be noticed that the tank core, except for a small core in the side of the mould, is entirely surrounded by metal, and supports the top core by means of ¾-in. studs. Incidentally, careful preparation must be made for leading the air away from the tank core. This is successfully accomplished by cutting out some of the

(*Continued at foot of next column.*)

U.S. IRON AND STEEL OUTPUT IN 1942

Production of steel ingots and castings by the steel industry of the United States for 1942 established a new record of 86,092,209 tons, reports the American Iron and Steel Institute. The total exceeds by 3,255,000 tons the previous record production of 82,836,946 tons in 1941, and is 70 per cent. above production in the record year of the last war. Of the year's output 5,553,248 tons (83 per cent. capacity) were Bessemer and 3,974,368 tons (99.8 per cent. capacity) were electric furnace steel. Output in the December quarter was a record of 22,072,603 tons.

Walter S. Tower, President, American Iron and Steel Institute, in a recent review of the steel industry, pointed out that the tonnage of steel ingots and castings produced in 1942 was 70 per cent. above the maximum production in any year of the last war. To meet the urgent demand for steel plates in 1942, works produced 11,600,000 tons of plates—almost 90 per cent. more than the record production of 1941. That tonnage was far above the capacity of the standard plate mills of the industry, and was achieved by making certain changes in the continuous wide-strip mills which a number of companies had installed, largely in the past ten years, to roll sheets and strip for automobile bodies and similar uses. In a very short time those mills were converted to roll the heavier product, with the result that at the end of 1942 they were rolling fully 45 per cent. of the plates produced.

Pig-iron production in 1942 was about 4,800,000 net tons higher than 1941 and totalled 59,334,735 tons. During 1942, the blast furnaces operated at an indicated rate of 99.2 per cent. Present annual blast furnace capacity is placed at 60,682,000 net tons. Blast-furnace output of ferro-manganese and spiegel dropped off from 730,000 net tons in 1941 to 647,422 in the past year.

Last year the United States exported under lend-lease the following percentages of her new supply of raw materials (current production plus imports in each case): Aluminium, 3.5 per cent.; copper, 7.2; molybdenum, 19.6; nickel, 1.0; steel, 7.3; tin, 0.1; tungsten, 0.9; zinc, 12.0 per cent. At the same time, imports of U.S. new supply for year 1942 were: Bauxite, 25 per cent.; chromite, 89; manganese ore, 88; mercury, 44; nickel, 100; tin ore, 99; tungsten, 62 per cent.

(*Continued from previous column.*)

core so as to expose the ashes. A length of ¼-in. piping is then pushed through the outside of the mould and into a hole in the side core, which is in line with the cut-out portion in the tank core. The side core measures 7 in. by 5 in. and is fixed in position before the bottom core is lowered in. When the end of the pipe has been pushed far enough so that it contacts the ashes in the core, as indicated at Fig. 3, the cut-out part is firmly made up and the top core placed in position.

SCIENTIFIC METHOD IN THE FOUNDRY INDUSTRY*

By B. S. MORGAN, B.Sc.(Hons.), A.I.C.

Rationalisation of Knowledge of Foundry Technique and Standardisation of Practice are Recommended as Basic Principles

The subject of this Paper is very different from those generally given; it is not on any definite branch of foundry work, and although foundry work is under discussion, the general principles stated here are equally applicable to other industries. Metallography, lattice structure and similar aspects of scientific work are not considered, but only that part of foundry work coming into everyday practice. Most of the remarks made here will apply to cast iron, but equally well do they apply to all other branches of foundry work.

On comparing the work of the foundryman with that of the engineer, it will be found that the latter gets results with less effort than is expended in the foundry. As far as can be ascertained, this is due to the fact that engineers have, for many years, been getting down to their problems, by experimenting, collecting data, tabulating these data and putting forward the results of their work in the form of curves or formulæ, all of which enables them to approach their problems in a better way than the foundryman can. They also specialise much more than the foundryman, and find it necessary not only to divide up engineering into its various branches, but also to subdivide these branches into sections, one person or more concentrating on each section. Do we find this in foundrymen? A foundrymen is more often than not expected to cope with ordinary cast iron, alloy cast iron, malleable, steel, and many non-ferrous alloys. If foundrymen had specialised only to a very small extent, they would have made much more progress than they have done, and when viewed from this angle it is surprising how much progress has been made.

Of course, in comparison with engineering, foundry work, although quite as complex, is a small industry, and has not the number of people to carry out these investigations. Firms do not give the attention to foundry work that they do to engineering. Many large firms have big research sections for their engineering problems, but it is very rare that the same policy is applied to foundry work. Perhaps foundrymen are partly to blame for this, as until recently they thought their problems were different from those in other branches of industry, whereas the same principles apply in the majority of cases. With great advantage to industry, recent years have seen a greater spirit of co-operation between foundrymen and engineers. Take, for example, the question of design; by consultation with the engineers changes have been made which has enabled the foundry to produce better castings; similarly by the efforts of the foundrymen, knowing better the requirements of engineers, they have been able to give them better service.

In spite of these difficulties, the author thought that the foundry industry could still make greater and faster progress, and make its task less worrying. Many people for reasons of their own think that a scientific approach to a problem is a new-fangled idea, whereas nearly everyone, although it may be in a very small way, applies scientific principles. Science to many means a collection of formulæ—this is not true; a formula is only a convenient method of showing a relationship between specific factors under investigation.

Accurate Measurements Only Approximate

The term "accurate measurement" will be frequently used; this does not imply that the measurement is absolutely correct, but that it has been made with the greatest care, using the most accurate instruments available. No measurement can be represented by a single number, but is a group of numbers lying between two well-defined limits which depend on the accuracy of the instruments, on the conditions of experiment, and on the experimenter. If a large number of measurements are made and they fall on a curve, an equation can be found. All laws which embody our knowledge of natural phenomena are approximations to the truth; the scientific worker is always seeking to get a better approximation, and although a single number may never be found, he is always narrowing the range within which it lies.

Again, equations and formulæ may be true only under certain conditions, and these must be stated. No mathematical formula or equation makes a law any more exact; it is merely a convenient way of expressing a relationship and showing one how to calculate a result. Whatever method is used to approach a problem and whatever instruments, etc., are used, every effort should be made to ascertain the degree of accuracy of each. Accurate methods of measurements, frequently, are of great difficulty; for example, measurements at high temperatures especially so, as measurements of properties at ordinary temperatures give no indication of the behaviour at high temperatures.

Qualitative Work

The first approach to any problem is a qualitative one, which shows the trend of various factors without giving any quantitative data. For example, an increase in the amount of a certain element in an alloy

* Paper read before the Lincoln Section of the Institute of British Foundrymen, Mr. H. T. Read, presiding.

Scientific Method in the Foundry

is said to increase the hardness, without giving any quantitative relationship. At a later stage, measurements are made and data collected giving the quantitative relationship between the percentage of the element under consideration and the resulting hardness.

A very good example of qualitative work, and one very important to foundrymen, is that dealing with defective castings. Scattered through foundry publications various defects and their probable causes are discussed, without any definite quantitative relationship being given. This will be more clearly seen in work on this subject now being published by the American Foundrymen's Association. They have formed a committee to investigate defective castings, and are publishing their results in the "American Foundryman." The work itself is not new, but a complete study of the subject is being made, correlating all the data, first of all by enumerating all the types of scrap and then studying each in turn, giving the probable causes, which are tabulated in a systematic way. Photographs of the defects are also given. There is no doubt that, when completed, it will be of great help to all interested in foundry work, and it is hoped that, with corrections and additions, it will be published in the form of a monograph for quick reference. This type of work will always be of a qualitative nature, as it is very difficult to see how quantitative data can be applied.

Quantitative Work

In quantitative work numerous difficulties crop up. What is the best method to use? What is the accuracy of the measurement, etc.? Fortunately a great deal of help can be got from other branches of sciences. The most accurate method known should be used, making a note of the degree of accuracy of the method; and all instruments used should be calibrated so that their accuracy is known. When making measurements for control of a process, it may be found that the degree of accuracy just stated is not essential, but in these cases it is of great advantage to know the probable errors of the methods used.

In analytical work, results of a complete analysis frequently add up to very near 100 per cent., duplicate results being identical or nearly so. This looks very impressive to an outsider, but does not deceive anyone who claims to be an analyst. When we consider the errors of experiment and the experimenter, the chance of obtaining these nearly ideal results is very small. It is surprising how frequently the arithmetic average of a series of results is taken as being nearest the truth, irrespective of the comparatively great variation in the results obtained.

In all experiments too much care cannot be taken; such methods as the estimation of carbon in iron and oxygen in copper in which a gas is passed over the heated material, although very simple in principle, demand every care, otherwise erroneous results are obtained. Another analytical method, equally simple in principle, is that of gas analysis. This method is used in many branches of industry, and a great deal of work has been done to eliminate errors. Present practice permits of considerable accuracy, yet unsuspected errors may arise from sources such as partially-exhausted chemicals, accidental leakage past cocks, mistakes in reading the percentage scale, etc. Fortunately, one can always check the accuracy of gas analysis in a very simple manner.

Reporting of Experimental Results

Whatever tests have been made, the next step is the reporting of the results. In addition to naming the method used, its degree of accuracy, etc., all data should be reported. It is frequently found that some results obtained show a great deviation from the majority and are omitted. This is entirely wrong, as these exceptional figures may at a later date be of value; of course, sometimes they are definite errors, but still should be reported with proper explanations. Many investigators when studying the results obtained often select only part of the data obtained, those data which fit in with some pre-conceived theory, the remainder being cast on one side as being erroneous. This action is not deliberate, and the investigator is satisfied in his own mind that he is correct in retaining certain data and discarding others.

The next stage in an investigation is to tabulate the results obtained, and if possible plot a curve. The curve, more so than a mass of numbers, presents a picture of the relationship of two groups of measurements. Many publications lose much of their value, because only the curves are reproduced and not the tabulated data from which the curves are deduced. The tabulated data are absolutely essential, so that others can correlate these data with that found in other Papers. After the points have been plotted, a curve is drawn in such a way that it represents the average of the points. This looks quite simple, but errors can be introduced as shown by the following case: A sample of wire was being tested by the extensometer method, in the usual way, in order to find the proportionality limit, and two curves plotted. In the one curve, for which readings were taken at loads at intervals of five tons per sq. in., the proportionality limit was 38 tons per sq. in. In a second curve with readings at more frequent intervals, the larger number of points gave a more accurate curve, with the proportionality limit at 22¼ tons.

Multi-Variable Processes

Plotting curves, when only two variables are concerned, is a comparatively simple matter, but in practice there are frequently more than two variables. To take a concrete example in the foundry, consider the cupola, which presents a very complex problem, as every element in its working is liable to variation, although it may be thought that some are constant. A recent Paper on the blast furnace by Mayers and Landon, of the Coal Research Laboratory, Carnegie Institute of Technology, is of great interest in this connection, and what is said below of the blast furnace can be applied to the working of the cupola.

They approach the furnace as a consumer of fuel, and discuss the relation of coke properties to blast furnace performance. The quality of iron produced depends greatly on the character of the coke. Tests have been developed to specify coke for blast furnace use, but there does not appear to be any relation between these test values and the performance of the furnace.

The reason for this is found in the extreme complexity of the blast-furnace process and the liability of many of the imposed conditions to uncontrolled, indeed uncontrollable, variations. Thus it has been impossible to run blast-furnace tests in which a single variable to be investigated is changed, while all other factors are maintained constant. In fact, the uncontrolled variations are usually so great that the effect of an imposed change may be completely masked by fluctuations of other factors.

Statistical Methods

The development of statistical methods has produced a tool for dealing with just such conditions. This is the method of correlation analysis by which the relationship between the different variables in a given problem may be calculated. The calculations, methods of which have been worked out in detail, permit an estimate of how large a proportion of the variation in a dependent variable is related to variations in any number of measured, independent variables, and what proportion remains unexplained and must be ascribed to chance variation and unmeasured independent variables. Furthermore, it permits an estimate of the magnitude of the dependence of the dependent variable on each of the measured independent variables. Statistical methods have already been applied to blast furnace work, and permitted the observation of relations between results and coke quality; without their use, these relations are completely obscured by the complexity of the data.

These methods permit the analyst to discover and evaluate relationships, which without their use would be inextricably lost in a maze of data. Among other advantages, the application of these methods will permit setting standards for day-to-day operations in which the effect of extraneous influences may be compensated. This may be expected to lead to economies of operation as great as those due to the same procedure on the operation of steam or power plants, where, as in the cupola, quantitative estimates of the influence of external factors have had to be made before a reasonable ideal of performance could be set up. Statistical methods can be applied, not only to the cupola, but also to other foundry problems.

Literature on Foundry Work

So far only the steps to be taken in any investigation have been given, but there is also another section of foundry work. Consider the very large amount of literature bearing on foundry work published in numerous journals in this country; in addition there are those published in America, France, and Germany. Publications in other branches of science are also of use to the foundryman, although care should be taken in borrowing from other sciences. The author recalls reading that carbon burning to carbon dioxide evolved a certain amount of heat, whereas if the carbon was first burned to carbon monoxide and this carbon monoxide then burned to carbon dioxide, there would be a loss of about 30 deg. per cent. in the latter case compared with the former. This is obviously wrong to any one who has studied the subject, but not so obvious to others who have not.

Some of the data and opinions in the large amount of publications available are reliable, some are crude approximations, and some unreliable. Practically every foundryman has devoted much time to reading the literature to aid him in his problems, and the author's experience would appear to be similar to that of others. Some time ago he started collecting data on the functioning of the cupola, omitting such aspects as the composition of the metal, etc. He did not get very far before meeting conflicting data and opinions. He continued with the work, and soon discovered that there appeared no end to the amount of information, published in the various countries. He also wandered into other fields of science, in which the combustion of fuel and utilisation of heat had been studied; here again the information was enormous. This accumulation of data went on for some time, until a short while ago it was found that the American Foundrymen's Association had started studying the problem under the Cupola Research Project, organised to direct a co-ordinated study of the theory and practice of melting iron in the cupola.

A.F.A. Cupola Research Project

The A.F.A. Committee has laid out a 3-point programme:—(1) To review the published literature; (2) to co-ordinate known data and publish this information in a handbook on cupola operation, and (3) to conduct research work so as to develop authoritative information on practices and theories at present unproved. The committee consists of some 80 of the best cupola experts and technicians in the United States.

The first two items mentioned in this work, namely, the review of literature, co-ordination of the data and publication of this information, are really essential for good progress. This procedure is emphasised recently by Connolly in a Paper to the American Chemical Society. In this Paper he gives the example of a man acquainted with the general field and, after a brief study of the literature, carries out an investigation which may take weeks, months, or years. From the mass of data collected there appear results of outstanding merit, and a patent application is filed. In many cases the patent is abandoned, as the patent examiner, relying solely on research in the literature on the subject which is available to anyone taking time to find and read it, proves that the major portion of the investigation is merely duplication. It is stated that as many as 30 per cent. of the U.S. patents are abandoned on these grounds.

Scientific Method in the Foundry

Connolly continues with the statement that investigators are too busy accumulating data to take time for a complete and critical valuation of either their own data or published data of others. From careful reading, sometimes between the lines, it is often possible to take one short mental step beyond a publication or small group of publications to make a discovery of far-reaching importance. If this state of affairs—costly reduplication of research—is not to continue, the investigator must give full attention to published literature. Connolly suggests that there is room for a new type of worker who will devote all his time to the thorough investigation of scientific literature, to avoid useless duplication.

Group Research Essential

The method of approach of this committee to the cupola problem is the only way to real progress; this applies to all foundry problems quite generally. It may mean an enormous amount of work, but this is well worth while. Even if we only collected and correlated all the data known up to the present, accepting the reliable data and rejecting the unreliable, this information would be extremely useful to the older men and more so to the younger ones. If the necessary groups were formed in this country and similar groups in other countries and there was a means of international co-ordination, it would not be many years before foundry knowledge was placed on a sound foundation, comparable with that of other industries. Besides forming these groups, it would be advisable to form, if not already existing, a central committee who would direct and co-ordinate this work and direct any future work.

Groups should be formed for the study not only of what is generally termed the technical side of foundry work, but also on such sections as costing, time-study, etc., to arrive at standardised methods giving easily comparable results. Standardisation to many is not a very welcome term, but it is really necessary if the best and quickest progress is to be made; it is the only method by which co-ordination and co-operation can be brought about. For example, some attention should be paid to the standardisation of the equipment supplied to foundries, especially moulding machines—at present there are far too many shapes and sizes. This lack of standardisation, especially in sizes, makes it very difficult when one wants help from other foundries, as the pattern plates, etc., are of different sizes and not interchangeable or complementary.

Correlation of Data

Reference has previously been made to curves, formulæ, equations and statistical methods. At first glance it could be concluded that it is necessary for all foundrymen to become expert mathematicians; this is not so, but a few would have to have a fair knowledge of mathematics. Taking first of all statistical methods; admittedly it is rather advanced work, but would well be worth studying by a few. Formulæ or equations would be developed, some quite simple and their solution not difficult, whereas others may be complicated and difficult of solution, which could be much simplified by the use of nomograms.

At times there appears a property of a material which appears to have an appreciable effect on the results obtained, whereas on further investigation this may prove not to be so. Take the chemical reactivity of coke. It is quite true that different cokes reduce carbon dioxide to carbon monoxide at different rates at one particular temperature, but what happens at other temperatures? It is stated that the chemical reactivity of coke can affect the rate of reduction of carbon dioxide to carbon monoxide only within a small temperature range. Above a temperature of 1,050 to 1,100 deg. C. the rate of reduction is almost independent of the reactivity of the coke, since it becomes, relatively speaking, a fast process, and is limited only by the rate at which carbon dioxide can be brought into contact with the coke surface by the scrubbing action of the gas. On the other hand, below 850 to 900 deg. C. the rate of reduction is negligibly slow for any coke hard enough to be used for blast furnaces. It can therefore be concluded that the chemical reactivity of cokes is only effective between about 850 deg. C. and 1,100 deg. C. If this is correct the reactivity of the coke is of negligible importance until a point well above the melting zone of the cupola.

Dietert's Work on Runners

Another important question in the making of castings is the size and location of runners. The literature gives much useful data on the size of the runners. The majority of foundrymen have studied the work of Dietert on size of runners; this work has been criticised on the grounds that the presence of cores, etc., are not taken into account. Dietert's curves are applicable to castings weighing up to 1,000 lbs. Both Dietert's work and that carried out in France show that there is a relationship between time of pouring and the weight of the casting. There is no doubt that if the running of non-ferrous castings were treated in the same way, a similar relationship would be found.

The method of running castings is another section of foundry work which should be standardised. Numerous cases can be found of one and the same casting being made by different methods in different foundries. In one foundry, by careful study of the method of running, size and position of runner or runners, the use of chills or risers are avoided; in another foundry chills are used, while in another risers are used, and frequently with the addition of chills. Surely the best method would be to avoid chills and risers, if this is at all possible. Of course, certain castings must have chills, others risers, and in some cases both risers and chills are found to be necessary. Similarly, in cupola practice, all cupolas of the same diameter should be worked in the same manner, so that results obtained in all foundries are comparable.

Scientific Method in the Foundry

DISCUSSION

MR. HALLAMORE (Lincoln), disagreeing with Mr. Morgan's contention that the engineering trade showed where the foundry industry had failed to bring its organisation up to date, said British foundries did specialise to some extent, but was specialisation essential to all foundries? Moreover, were foundries to sub-divide their classes of work on the engineering model? He doubted if it was desirable to make any reduction in the variety of moulding machine designs at present in use. The cupola was notoriously inconsistent in its conformation to any fixed rules for operation and, in view of geographical variations in coke quality, atmospheric conditions, etc., he queried the possibility of universal principles for cupola operation based only on difference in size.

MR. MORGAN said that, taking it for granted that specialisation was practised to a limited extent in this country, its adoption had invariably led to a remarkable increase in productive efficiency. Specialisation, generally associated with intensive mechanisation, was beyond the reach of average foundries, but, whatever the size of foundry, it would improve its present performance by concentrating on one class of work only. Quite small foundries frequently run cast iron, steel, Monel, white metal, etc., and, in general, still regard founding as making a hole in sand and pouring metal into it. Each of these metals constituted in itself a study for expert theory and practice; therefore, this common aspect of faulty foundry organisation must go. The types of moulding machine were not under criticism, but, where different makers manufacture similarly designed machines, then they should conform to a standard specification for size and location of pins, pattern draw, etc. He suggested that cupola operation, in all major principles, could be standardised without reference to weather conditions, whose influence on metal quality, in any marked degree, was still not proved.

A Simplified Physics Text Book Needed

DR. WALTER (Lincoln) said that science remained but loosely rooted in foundry technique, due to the immense number of variables to be considered. Greatly as he admired the practical science of the moulder, undoubtedly the education of future foundry apprentices must be remodelled on scientific lines. The present type of technical books on physics did not encourage the practical man to learn the whys and wherefores of his trade.

MR. MORGAN, in reply, said that he had not been bred to the foundry industry and could not quote himself as a foundryman; however, he did enjoy reasonable success in making castings, perhaps more so in that he had no tradition to guide him. He considered that many of the foundryman's problems should be solved by people other than foundrymen; for example, cupola trouble should be tackled by a combustion engineer, not a founder. The comprehensive apprentice schemes of the engineering trade had no parallel in the foundry industry. Certainly, the complexities of founding were a stumbling block in the successful training of apprentices, but much of the complication could be removed by efficient correlation of the data on founding—at present existing in a mass of monographs, treatises and reports scattered confusedly throughout the country.

Profit and Efficiency

MR. DUNLEAVY said he could see nothing to prevent standardisation in founding technique. Rate-fixing, costs and, to some extent, moulding materials were already conforming to general basic principles throughout the country. Therefore, if a casting was made satisfactorily in Lincoln, why not adopt the same process of manufacture elsewhere? The Non-ferrous Sub-Committee was sifting thoroughly all possible variations and problems in melting technique, and it was a considerable extension of this class of work which would result in set standards of foundry practice for universal use. Frequently the foundries were solely responsible for the variety of work undertaken, but, at present, they often had to tackle unfamiliar, but profitable, lines of work in order to compensate for other unprofitable, but labour-employing, jobs, *i.e.*, turnover (to reduce overheads) and profit displace efficiency as the basis for production. This was most evident in the jobbing foundry. The visual pyrometer gave excellent results for use, comparatively, in any foundry. Difficulty arose because these pyrometers gave figures which altered according to the individual operator and other variables, and few foundries bothered to keep a standard correction figure. Regarding the cupola, some authorities stated that wet coke had adverse influence on metal at the spout; this would render standardisation difficult. Finally, he regarded the modern trend to institute exhaustive scrap analysis as a good foundation on which to evolve standards in founding technique.

MR. MORGAN agreed that the jobbing founder's policy was influenced by economic considerations, and he could only see amalgamation or deletion as the logical evolution of this section of the foundry industry. Fear of competitive plagiarism still caused many founders to regard the statistician with suspicion. He regarded the wet coke theory as a myth, because the considerable temperature of the stack would eliminate or dissociate moisture long before it could influence the metal quality, but free passage for exhaust gases was essential. Before criticising the metal used, it was preferable to increase the knowledge of its properties.

Coke Reactivity Tests Need Revision

MR. G. L. HARBACH said he regarded the true appreciation of a formula's capabilities and limitations as an essential feature of the scientific approach to any problem. He considered that the information on gas absorption by molten metals and alloys was at present inadequate and increased attention to this problem would be an active help in the fight to reduce scrap. Coke was tested for chemical reactivity at a tempera-

(*Continued on page* 328.)

NEW CORE DEPARTMENT AT MOUNT VERNON FOUNDRY

The new core department at the plant of The Cooper-Bessemer Corporation at Mount Vernon, O., one of America's oldest diesel and gas engine manufacturers, cost $300,000. The new building will embrace some of the latest methods of handling core sand by the carload in the most direct manner. The plant was built to relieve the overcrowded condition which has prevailed for months in the Corporation's foundry, and has a floor space of 140 ft. long and 120 ft. wide. Underneath the floor are huge pits for the storage of the core sand as it comes in on hopper-bottom freight cars. A special spur track was constructed alongside the building to bring the cars right to the door of the core plant. The pits open underneath the tracks, and as the cars are pulled up, the sand can be dumped without delay, permitting immediate release of the cars for other runs. Previously the sand had to be removed from the cars by means of a steam shovel and then placed into bins. From the extension of the pits inside the building, the sand is lifted by a skip hoist and dumped directly into the sand muller. From here the sand is picked up and carried to where it is needed by means of electric trucks. When these two methods of transferring sand into the core plant are compared, the great amount of time saved is evident. Newer methods of handling sand in foundries as well as improvements in methods of moulding have greatly stepped up foundry efficiency. The core plant has seven new ovens for core drying. Four of these are constructed to accommodate cores for the largest compressors. Each large oven is 25 ft. long, 6 ft. wide, and 10 ft. high. The three others are 13 ft. long, 6 ft. high, and 7 ft. wide.

CENTRIFUGAL CASTING

One of the most significant developments in steel castings in America is the pioneering work done on centrifugally casting long tubular shapes up to 16 ft. long and with side walls up to several inches in thickness, says RAYMOND L. COLLIER, of the Steel Founders' Society of America, Cleveland, in a review of technical progress in 1942 in "Steel." The ingenious methods employed make possible the integral casting of flanges on the end of such sections, if desired. The technique appears promising for future exploitation, he believes.

HAROLD J. ROAST, of the Canadian Bronze Company, Limited, Montreal, deals with the non-ferrous side, and points out that the ever-increasing demand of the war effort on the American bronze foundries and bronze castings has brought many problems. A great deal of the hesitancy of the engineer to use castings instead of welded or forged structures is due to the internal defects of castings which are caused by lack of proper manufacture is well as proper inspection. In this connection, he considers there is a growing demand for centrifugally cast products, both those cast in chill moulds and those in dry sand moulds. Then again, there is an increasing need for castings made in chill moulds even without the centrifugal operations—for example, pressure discs that are required to be entirely free from internal intercrystalline shrinkage. Now that tolerances of machined castings are required to within 0.001-in. on diameters as high as 4 in., changes in measurement occur after machining. This emphasises the need of heat-treatment of bronze castings before machining and in some cases even after rough machining. Centrifugal, chill and heat-treated or annealed castings have an expanding future, he suggests.

Flaw Detection by Fluorescence

Under the trade names of Magnaglo and Zyglo, the Magnaflux Corporation has introduced two new fluorescent substances for the detection of flaws in metals. Magnaglo is in paste form and is used in connection with the Company's Magnaflux equipment on parts of magnetised or magnetic metals. Zyglo is a liquid and is applied to non-ferrous metals to disclose defects that extend well below the surface. Scratches or minor surface irregularities are not shown. Both glow in black light.

SCIENTIFIC METHOD IN THE FOUNDRY INDUSTRY

(*Concluded from page* 327.)

ture of 900 deg. C., and he thought this figure, while useful for data on coke as a substance, was unsuitable when considering the probable behaviour of bed-coke which held a temperature of approximately 1,500 deg. C.

MR. MORGAN, in reply, said that practical formulæ derived by statistical methods were based on the probability of error and were not immune from exceptions and irregularities. He agreed that 900 deg. C. was an inadequate temperature at which to assess the chemical reactivity of coke for cupola use, but, as before mentioned, he did not consider cupola melting reactions as entering the foundryman's province. The foundry should make more use of specialised knowledge for the solution of many of its problems and could study, with advantage, the engineer's use of clearly defined measures and standards. Facts and data must oust tradition.

Vote of Thanks

MR. G. L. HARBACH, in proposing a vote of thanks, agreed thoroughly with the author's recommendation that outside knowledge be brought to bear on foundry problems, especially as external advice will frequently shed an entirely different light on a long-standing difficulty. The collection and correlation of data will be difficult, but it must come.

MR. BINGLEY, seconding, emphasised the need to make the training of foundry apprentices both scientific and inclusive of all branches of founding.

After Mr. Morgan had replied, the meeting was closed.

ACID RESISTANCE AND TECHNICAL CONTROL IN AN ENAMELLING PLANT

Glass-Lining of Cast Iron — Experiments with Copper — Observations on Test Plates Continued from p. 303

By W. MONTGOMERY

The Glass Lining of Cast Iron

The application of resistant silicate coatings to iron castings is more difficult and sometimes more hazardous than the processing of mild steel. It offers more scope for individual research and probably, for this reason, has a greater appeal for the enamel technologist. The composition of the enamels requires modification to accommodate them to the characteristics of cast iron while the technique of application must be varied to suit this alternative base metal. In the field of acid-resisting enamelled chemical equipment, cast iron offers attractive possibilities. The cheapness associated with the manufacturing methods used in the production of iron castings of a repetition and standard nature is, in itself, a recommendation. The limiting factors are, naturally, design and size. The author has continually advocated the use of, and tried to develop, glass-lined cast-iron fittings for chemical equipment, such as pipes, flanges, valves, stills, evaporators, and reaction pots.

The fundamental difficulty lies in the fact that these silicate glasses, which are, of course, true enamels, have a much higher fusion range and are more refractory than the general run of enamels used in the light-castings enamelling section of the industry. It must be understood, however, that by and large, the methods of applying and processing these coatings conform to the tenets of good enamelling practice wherever carried out. The dry dust method is of greater applicability, but the wet process is also used on occasions.

An idea will be obtained, from the photographs, of some of the regular applications of silicate coatings to iron castings. Fig. 19 shows a wet-sprayed chemical pot with a bottom outlet. The cover shown in Fig. 20 is about 5 ft. dia., ¾ in. thick and has openings for a man-hole, a thermo-pocket and branch connections. This is a hot-dusted job.

Fig. 21 includes a well-known type of valve which is regularly enamelled and a cast-iron stirrer. A cast-iron enamelled pipeline assembly is shown in Fig. 22, with a reducer bend and T-piece clamped together. It may be stated that when these silicate-lined castings are commissioned they are called upon to withstand extremely corrosive conditions (as for example nitric acid and even chlorine gas in the presence of wet hydrochloric acid) and stand up well to the service.

FIG. 19.—GLASS-LINED CAST-IRON CHEMICAL POT.

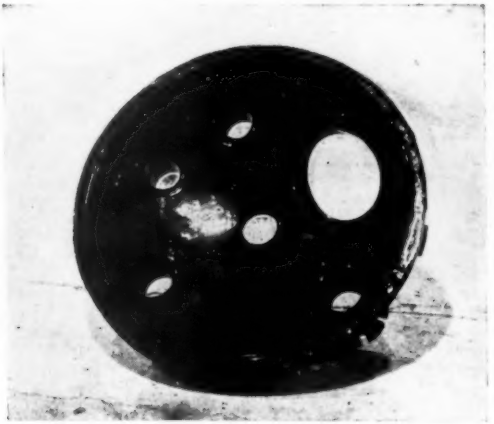


FIG. 20.—ENAMELLED CAST-IRON REACTION VESSEL COVER.

Foundry Practice and Composition of Iron

The genesis of the entire process lies in the cupola

Technical Control in Enamelling

and in the proper selection of melting stock. No additional precautions are necessary, over and above the ordinary sensible care taken in the average foundry, to obtain clean, hot and unoxidised metal. If those conditions prevail there is no need to employ special fluxes and ladle dopes as is sometimes advocated.

Attention paid to moulding details is well worth while; sand practice is often deserving of care and a review of gating methods will pay a dividend at a later stage if good clean castings with favourable surfaces be the accepted criteria of good enamelling stock. Gates should never be dropped directly on to the cores or moulds, if at all avoidable, as this often results in loose sand being carried into the casting by the primary stream of metal. The ideal method of using cut gates with shrink bobs or dirt traps should be used where possible. The temptation to sleek the moulds and cores with plumbago should be stoutly resisted, for the number of subcutaneous blowholes in the resulting castings will be directly proportional to the amount of facings used. A light

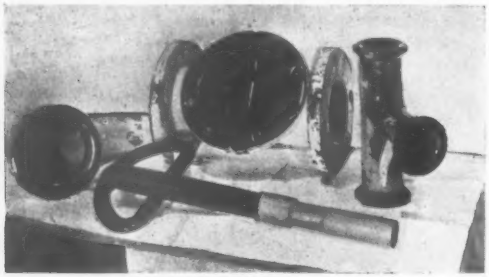


FIG. 21.—CAST-IRON VALVE, STIRRER AND PIPES, LINED WITH ACID-RESISTING GLASS.

dust with a mixture of plumbago and talc will be sufficient to prevent the sand from burning in, and in the case of dry or oil sand cores, personal practice is to apply a thin wash of the following composition: 4 lbs. plumbago, 4 lbs. terra flake, ½ lb. "treacle," 3 galls. water.

The chemical composition of the base metal is really of only secondary importance. Although it may seem rather sweeping it must be asserted that, given a clean casting, the microstructure is the all-important point. Troubles will be halved if the carbides are completely broken down and the graphite is precipitated in as fine a form as is practicable. Although some have claimed that pearlite iron makes the best base for enamel and others have demonstrated that solid graphite may be given a vitreous coating, these results must be regarded as, if not freakish, at least being of limited applicability. The high temperature anneal which is usually given to enamelling castings in order to "burn out" extraneous matter from the iron surfaces has the added effect of causing pearlite breakdown and this, in itself, is worth striving for. It is, naturally, agreed that the atttainment of a suitable microstructure is not entirely independent of the chemical analyses. The silicon content, for instance, has a decided influence on the attainment of a fully ferritic matrix after the annealing treatment.

Copper in Cast-Iron Enamelling Stock

In the beginning, this investigation was undertaken to inquire into the possibilities underlying the use of an engineering grade of iron with regard to vitreous

FIG. 22.—ASSEMBLED ENAMELLED PIPE, REDUCER AND TEE-PIECE.

enamelling. In particular, the requirement of the moment was a cast iron which would be tight to a considerable water pressure after processing, *i.e.*, sand-blasting, annealing and enamelling. It was to be used in the production of still castings which, in shape, resembled furnace pans. The inner vessel had to be enamelled in the inside and both the inner and outer jackets had, as is mentioned above, to be pressure tight.

The castings were originally bought from a light castings enamelling firm, and although the enamelling properties were fairly good, they were quite porous to water under pressure. The analysis of this iron is compared below with that of an average general engineering type of casting (see next page).

The difference in the silicon and phosphorus figures will be noted. The phosphorus content is too high, in the first instance, for pressure work. The enamel-

	High Phosphoric Iron Per cent	General Engineering Iron Per cent
T.C	3.20	3.00—3.30
Si	2.49	1.80—2.00
Mn	0.49	0.60—0.80
S	0.067	*circa* 0.070
P	1.25	0.40—0.50

ling potentialities of the engineering class of iron were tried out by casting test cups the same shape and section (¼ in.) as the stills. All these test castings

FIG. 22A.—MICROGRAPH OF ORDINARY ENGINEERING TYPE OF CAST-IRON HELD AT 850 DEG. C. FOR 30 MINS. UNETCHED (× 100). WITH LARGE GRAPHITE FLAKES.

were given a pressure test before enamelling and were perfectly tight up to 100 lbs. per sq. in. A dozen of these were then annealed at the enamelling temperature for a period of time equal to that of ordinary firing practice and on repeating the pressure test all leaked badly at 60 lbs. per sq. in. The reason for this is that, on annealing the castings, the graphite plates which are relatively thick and coarse become more or less oxidised at the surface, while the growth and cracking which take place along the graphite planes break up the continuity of the metal.

It follows that the graphite refinement associated with the use of alloys might offer a solution. A 1 per cent. addition of nickel was tried with perfectly satisfactory results. The test cups were enamelled with a good finish and were pressure tight. It may be recorded that a batch of cups which had an accidental surface chill gave very little enamel adhesion.

A few deductions concerning the enamelling of engineering irons can be made from the above findings. First, a fine graphite structure is advantageous. Secondly, the more graphitisation has progressed (pearlitic breakdown) before enamelling the better. In a light casting this is attained by higher percentages of silicon and phosphorus being present, and free ferrite is nearly always evident in the microstructure of such an iron. In engineering irons the graphitising effect and refining action of certain alloys might be beneficial.

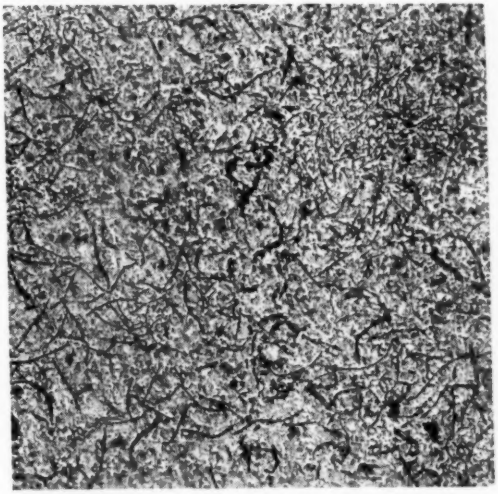


FIG. 22B.—MICROGRAPH OF ORDINARY ENGINEERING TYPE OF CAST IRON HELD AT 850 DEG. C. FOR 30 MINS. ETCHED WITH 4 PER CENT. PICRIC ACID (× 100). MUCH PEARLITE SHOWN.

Experiments with Copper

The use of copper in this respect suggested possibilities. At the time of the investigation it was plentiful and it was cheap. It could be conveniently alloyed with cast iron and for all the following tests the copper was added, in the form of clean scrap clippings, to hand ladles prior to filling at the cupola spout.

Commercial cast iron can dissolve about 6 per cent. of copper when molten and the amount present in excess of this quantity solidifies in the form of copper-rich globules, which are termed primary copper. As the temperature falls to 750 deg. C., so does the solid solubility in gamma iron decrease till it reaches 3.5 per cent. Of the copper dissolved in gamma iron, only about 1.0 per cent. is soluble in alpha iron (the low-temperature form), and as the temperature decreases through the critical range, any copper in ex-

Technical Control in Enamelling

cess of this amount is precipitated as secondary copper, which is not resolvable under the microscope unless very high magnifications are used. However, this secondary copper is not revealed by microscopic examination of cast irons containing less than 3.5 per cent. copper; hence this amount has been termed the "apparent" solubility. The real solubility of copper in commercial cast iron probably lies in the region of

FIG. 23A.—MICROGRAPH OF COPPER-BEARING CAST IRON HELD AT 850 DEG. C. FOR 30 MINS. UNETCHED (× 100). FINE GRAPHITE FLAKES AND SIGNS OF SUPERCOOLING.

1 per cent. or less, depending on the amounts of other elements present.

It is claimed that copper exerts no influence on the breakdown of pearlitic carbide. This is accepted as applying to castings which are fairly rapidly cooled in the moulds, but it is the author's opinion that submicroscopic secondary copper serves as nuclei for the precipitation of graphite from the eutectoid iron carbide, at least on slow cooling and most certainly on annealing. This is the mechanism on which the following tests are based, for it is generally accepted that, in higher pearlitic irons, the breakdown of the carbide plates at enamelling temperatures gives rise to trouble.

Thus, it was considered that the graphitising influence of the copper would facilitate the graphite and ferrite formation at lower temperatures as well as refining the structure with beneficial results in the enamelling shop. There would be no chance of obtaining a chilled surface on thin sections of engineering quality metal, and the fluidity of these low-phosphorus irons would, if anything, be improved by copper additions.

K. Emmel (Giesserei, 1939, **26**, 285-287) stated that enamel adherence on surfaces of ferritic iron, even when highly graphitised, was very good, but he found that practically no adherence was obtained on fully pearlitic irons. This latter structure is typical of engineering irons in the as-cast condition, and thus the

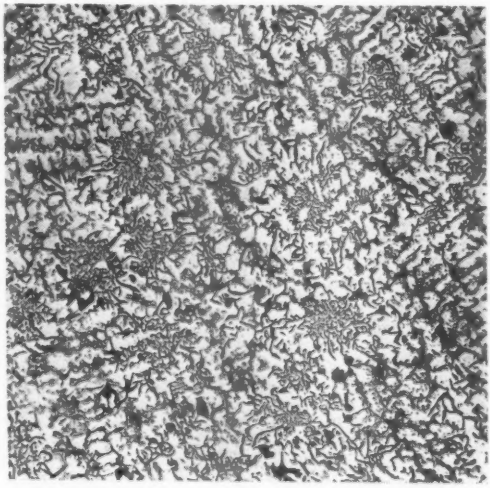


FIG. 23B.—MICROGRAPH OF COPPER-BEARING CAST IRON HELD AT 850 DEG. C. FOR 30 MINS. ETCHED WITH 4 PER CENT. PICRIC ACID (× 100). PEARLITE BREAKDOWN NEARLY COMPLETE.

aforementioned tendency of copper to promote the formation of ferrite and fine graphite would be a decided advantage.

Observations on Test Plates

Eight series of test plates were cast in green-sand moulds with metal of substantially similar composition, but to each series of at least a dozen plates was added an increasing increment of copper. Thus, Series A contained no copper; Series B, 0.55 per cent.; Series C, 1.12 per cent.; Series D, 1.51 per cent.; Series E, 2.20 per cent.; Series F, 3.05 per cent.; Series G, 4.10 per cent.; Series H, 5.20 per cent.; and Series J, 6.00 per cent. There was a slight variation in the analyses of the higher copper groups, due to a dilution effect.

The composition of the base iron was as follows:—

(*Continued on page* 334.)

INSTITUTE OF BRITISH FOUNDRYMEN

NOTES FROM THE BRANCHES

Lancashire Branch

The annual general meeting of the Lancashire Branch was held at the Engineers' Club, Manchester, on April 3, Mr. E. J. L. Howard, Branch-President, being in the chair.

Secretary's Report.—In his Annual Report, MR. BUCKLEY stated that the past year had been quite successful, eight meetings having been held, and the subjects covered by the Papers read had been of interest to every section of the industry. The attendances might have been better, but the prevailing conditions of travel had had a direct effect, though there was some consolation in the fact that the standard of discussion had been of the highest quality. That in itself was an indication of the healthy condition of the Branch, and must certainly have given their President some satisfaction, for it was he who gave the lead and the energy Mr. Howard had shown in keeping the Branch alive, reflected in the substantial increase in the membership during the past twelve months. Since the last annual meeting two subscribing firms had been admitted, ten new members had been elected, and 24 associate members; three had been transferred from associate members to members and two from associates to associate members. After deducting five resignations received during that period there was a net increase of 31, which was certainly very creditable. If the membership could be increased at the same rate during the next 12 months, he could see no reason why the Branch should not reach the 400 mark before the next annual meeting.

The Burnley Section had had another good year, five meetings having been held, at which a variety of subjects were discussed. The Section celebrated its 21st anniversary last month, and the Council wished to thank all those who sent messages of goodwill. Mr. Buckley expressed his thanks to the President and members for the assistance they had given to him.

The report was adopted, several speakers declaring that the Branch had been fortunate in securing the services of Mr. Buckley as secretary.

In moving a vote of thanks to the retiring officers, MR. PHILLIPS remarked that this was the only opportunity those who served them in an official capacity had of getting a pat on the back for the excellent service they rendered. Mr. Howard, in the position of President, had done his job exceedingly well, not only in Branch affairs, but in outside spheres, such as on the Fuel Committee. He had brought the Branch into the forefront of associations.

MR. FLOWERS, in seconding, said that, in his view, the ordinary members did not appreciate as much as they should the importance of having officers showing such gifts of leadership. Those responsible for the management of the Branch affairs were deserving of high praise for the fact that, in spite of the strenuous times through which the country was passing, they had maintained an uninterrupted session during the war.

The resolution was carried with acclamation.

MR. HOPWOOD, Senior Vice-President, asked for the support of those present in persuading Mr. Howard to continue as President for another twelve months, and a resolution to that effect was adopted unanimously.

Mr. Howard thanked the members for the confidence they had shown in him by asking him to retain office for another year. He also thanked the Council, and the secretary in particular, for the excellent support they had rendered him in the carrying out of his duties. Many complimentary remarks had been passed on the manner in which Mr. Buckley had filled the position of secretary and he took the opportunity of endorsing all that had been said.

There was one point he would like to emphasise; the success of an institution did not depend on its officers alone but on the attitude of the members as a whole and the members of that Branch had shown their desire to further the interests of the Institute of British Foundrymen generally by turning up at the meetings they had been able to hold. Unfortunately they had not yet regained their old position as the largest Branch in the country but they were comparatively few behind London and he was hoping that by the end of this term of office they would have exceeded the figures of the London Branch and earned the reputation of being the most practical Branch. It was the intention of the Committee to provide, if at all possible, more facilities for the non-ferrous side of the industry, and in furtherance of that object an extra meeting was being held on May 1, when a Paper on "Light Alloys" would be submitted by Mr. Wells, of J. Stone & Company, Limited, Deptford, London.

Mr. Hopwood was re-elected Senior Vice-President and Mr. Brookes Junior Vice-President. Mr. Phillips and Mr. J. Jackson were appointed representatives on the Technical Committee, Mr. F. A. Harper, Treasurer and Assistant Secretary, and Mr. R. R. Hargreaves and Mr. G. Studley, Auditors. Mr. A. Sutcliffe, Mr. H. Haynes and Mr. D. Fleming were elected members of the Branch Council for three years and Mr. J. Taylor for one. Mr. J. Jackson, Mr. W. Holland, Mr. A. L. Key and Mr. W. N. Cook were elected representatives on the General Council for one year.

West Riding of Yorkshire

The annual general meeting of the West Riding of Yorkshire Branch was held on April 3, at Bradford Technical College, under the Presidency of Mr. F. Oldershaw. The first business was presentation of the prizes, offered by the Branch, for the three best contributions in the recent "Short Paper Competition" among members, which had produced eleven excellent Papers, all of them read at the February meeting, and the prize-winning contributions discussed at the March meeting. The awards were: 1st, Mr. J. W. Nicholls, of Halifax: "Hints on Founding Low Carbon Cast Iron"; 2nd, Mr. W. Jones, of Bradford; "The Introduction of Female Labour into the Foundry," and 3rd, Mr. R. Oldershaw, of Halifax: "The Training of the Foundry Apprentice."

The President, in making the presentations, congratulated the recipients on their success, and expressed the thanks and appreciation of the Branch to all the eleven contributing competitors. He said he believed it was general opinion that the idea had proved a great success, and provided two of the most useful evenings in the history of the Branch.

Mr. S. W. Wise (Hon. Secretary), submitting the Annual Report, felt it would be agreed that the work of the past session reflected great credit on officers and members alike in being able to maintain practically normal activity through more than three years of war conditions. The geographical difficulties of the West Riding Branch area, under the past session's heavily curtailed transport facilities, were a serious handicap to the maintenance of that close co-operation which made for a successful and vigorous organisation. The session began with a thoughtful and topical Presidential address by Mr. F. Oldershaw, and his good start has been closely followed throughout. There had been Papers of outstanding character by Mr. J. Blakiston and Mr. G. Burgess, and Mr. Gardom had given an interesting lecture in which members were given a clear insight into the work undertaken by the Institute in aid of the national effort. Perhaps the outstanding event of the session had centred round the Short Paper Competition, which had brought out efforts from members who had not hitherto contributed to Branch transactions. The task of reading eleven Papers at the February meeting put the Branch under the debt of gratitude to Mr. D. Jepson, M.Sc., whose assistance to the conduct of the competition was invaluable. The Branch was fortunate in having among its members four founders of so wide an experience to act as judges as Mr. S. Carter, Mr. H. Forrest, Mr. A. S. Worcester, and Mr. W. G. Thornton.

The social side of Branch activity had had to be suspended under prevailing circumstances, but in spite of all difficulties the interest of the members remained unabated, and as membership continued to increase with each session, they could look to the future with confidence. The Branch had been honoured by the presentation of the Institute's Diploma to one of its members, Mr. J. Blakiston, for his Paper at the Annual Conference on "The Substitution of High-Duty Cast Iron for Steel Castings," and also the presentation of the Institute's Meritorious Services Medal to the Branch Hon. Secretary (Mr. S. W. Wise).

The following officers were elected for the coming year: President, Mr. Louis Turner (Elland); Senior Vice-President, Mr. J. Blakiston (Halifax); Junior Vice-President, Mr. J. Timbrell (Bradford); Hon. Treasurer and Secretary, Mr. S. W. Wise (Bradford); additions to Branch Council, Mr. R. Oldershaw (Halifax), Mr. J. W. Nicholls (Halifax), Mr. W. Jones (Bradford), and Mr. J. Stott (Keighley), with Mr. Gilbert Jackson (Leeds) in reserve; Hon. Auditors, Mr. H. Forrest and Mr. W. G. Thornton (both Bradford); Hon. Librarians and Registrars, Mr. C. Hall and Mr. F. Squires (Bradford); Representatives on Institute's Technical Committee, Mr. S. Carter (Huddersfield) and Mr. H. Forrest (Bradford); delegates to General Council, Mr. W. G. Thornton (Bradford) and Mr. A. S. Worcester (Huddersfield).

The evening closed with a discussion on the programme for the next session.

ACID RESISTANCE AND TECHNICAL CONTROL IN AN ENAMELLING PLANT

(*Continued from page* 332.)

T.C, 3.25; Gr, 2.55; C.C, 0.70; Si, 1.95; Mn, 0.75; S, 0.076, and P, 0.44 per cent. In accordance with convention the plates were all given a preliminary anneal. under conditions of standard time and temperature. After sand-blasting they received a ground-coat. The cover-coats were fired on by the hot dust method at 800 deg. C.

The plates containing the higher percentages of copper need not be considered because, as was expected, the primary copper tended to coalesce at the firing temperature, and resulted in no surface adhesion when the enamel was applied. The unalloyed base iron plates gave erratic results and showed a distinct tendency to produce pin-holing and blistering defects. In short, the plates containing between 1 and 2 per cent. of copper enamelled perfectly with a flawless finish and a stronger grip. Under repeated impact, the enamels fired on to the copper-irons gave better adhesion values and showed less tendency for the ground-coats to strip than did the plain-iron enamels.

A number of similar plates were studied microscopically to determine the effects of copper on the annealing times necessary to complete pearlite breakdown, and also to note the effect of this alloy on the graphite structure. Representative micrographs are shown in Figs. 22a to 23b. Figs. 22a and 22b show the unetched and etched structures, respectively, of an unalloyed iron to the analysis given above, while the same base iron with 1.50 per cent. of copper is shown in the unetched and etched conditions in Figs. 23a and 23b. Both irons were annealed for 30 mins. in the same furnace at 830 deg. C. The notable points are: (1) Decomposition of the pearlite is practically complete in the case of the copper iron, while it has not progressed very far in the unalloyed metal. (2) The graphite in the alloyed iron is much finer in form and tends towards a supercooled structure. The indications are that graphite of this form is less liable to oxidation in the enamelling furnace.

Some doubt has lately been thrown on this graphite-oxidation theory by some able American workers, who postulate that dissolved hydrogen is thrown out of solution, at enamelling temperatures, into the graphite cavities, where a reaction may take place with the formation of a gas of the methane type. Whether one accepts the hydrogen theory as being the genesis of pin-holing in cast-iron enamels or holds to the more classical ideas of the evolution of carbon oxides, it will be accepted that control of graphite size is a step in the right direction.

(*To be continued.*)

INCOME-TAX ASSESSMENT PROCEDURE

APPLICATION UNDER CONCENTRATION SCHEMES

Income-tax is once again in the picture, as forms are being received requiring return of income for year ending April 5, 1943, and this applies to both Schedules D (business profits) and E (employments), although for D an earlier year-ending date can apply, according to the firm's accounting year ending date (*e.g.*, December 31, 1942). This article is confined as far as possible to the more recent alterations and new provisions concerning assessments, space preventing more than a brief reference to older matters.

Amounts paid for National Defence Contribution and Excess Profits Tax, and premiums payable under the War Risks Insurance Act, 1939 (*e.g.*, Commodities Scheme) are deductible for income-tax purposes, but amounts paid under either of the insurance schemes of the War Damage Acts, 1941 to 1943, are not deductible.

Interest received where Treasury Tax Reserve Certificates (issued in advance of tax payments) are taken out is not assessable, but interest received where War Damage Act contribution is paid in advance is assessable, the discount of 2½ per cent. previously allowed under Schedule D for tax paid in advance is not now allowed.

The firm which joins another firm (the "nucleus" firm) is assessable to tax on the profits received from the "nucleus" firm, and "wear and tear" percentage allowances are given for machinery and plant, even though the machinery, etc., is not being used for the period under review.

Accounts, balance-sheets, etc., must be produced on request of the Commissioners, and books must be open to inspection if required, but this power is not likely to be exercised unless a return of income has been asked for and not sent along.

The allowance given for Life Assurance premiums, operates after taxable income has been ascertained, and is restricted in several directions, and as regards that provision which restricts the allowance to one-sixth of total income, the total income figures for year ending April 5, 1939, if higher, can be substituted for the figures which would currently apply; this is to the advantage of taxpayers "hit by the war" with current incomes smaller than pre-war.

Travelling expenses to and from business are not ordinarily allowable, but a special allowance is now obtainable (up to £10 a year) if extra expense is incurred on this account, through place of business or place of residence having been changed on account of war circumstances.

Wear and Tear Allowances

The wear and tear yearly percentage allowances given for depreciation of machinery and plant (term a wide one, including motor vehicles and fittings and fixtures) continue, and the extra one-fifth still obtains (*e.g.*, motor vehicles 20 per cent. plus one-fifth (4 per cent.), making a total of 24 per cent.), and as regards motor vehicles if it is considered that the normal allowance is not sufficient, owing to wartime working, a further one-quarter is obtainable. Furthermore, for machinery and plant generally, it is possible to get increases, if the machinery, etc., is worked overtime or continuously as against normal working in normal times. There is also an extra allowance for exceptional depreciation of buildings, machinery or plant (provided since January 1, 1937), which consequent upon the end of the war may be redundant or have depreciated in value; if the case seems clear for this allowance a yearly allowance on account currently may be obtained. A.R.P. items of the nature of machinery or plant attract wear and tear percentage allowances (*e.g.*, fire appliances, air filtration plant, etc.).

Otherwise A.R.P. expenditure is allowed as a trading expense, good examples being cost of equipment or stores for first-aid parties, respirators, protective clothing, wire netting, blinds, screens, dark paint, training of staff, etc.

PUBLICATIONS RECEIVED

Oxy-Acetylene Machine Cutting of Rolled Armour Plate. Published by the Department of Tank Design of the Ministry of Supply, Shell Mex House, London, W.C.2.

The publication of two Bulletins on this subject is of interest to our readers because they deal with a process competitive to the foundry. Many of the assemblies made, through its use, are, in America, made as steel castings. The subject covered is carried a stage further in the second Bulletin, which illustrates and describes a new design of cutting nozzle which has been developed by the Department of Tank Design. The make up and general appearance of these two bulletins show no signs of wartime austerity.

Heat-treatment of the Wrought Aluminium Alloys, Part I, Practice. Issued as Bulletin No. 3 by the Wrought Light Alloys Development Association, 63, Temple Row, Birmingham, 2.

This is the most intelligently compiled booklet so far examined by the reviewer. It is full of practical hints and pleasingly free from the plus or minus one degree Centigrade nonsense. The tolerances given are those entering within the range of practical politics. An appendix is included dealing with the underlying theory, and it is so well presented that anybody with an elementary knowledge of technology can easily follow the argument enunciated. Any of our readers who have to control the heat-treatment of light alloys can, on writing to the Association, obtain a copy free of charge.

Skilled engineers and industrial experts in Germany are now being called to the colours; no further deferments from military service will be granted.

INDUSTRIAL ELECTRICAL EQUIPMENT

The Minister of Supply has made an Order under which the disposal and acquisition of industrial electrical equipment is, except in circumstances defined in the Order, subject to licensing by the Directorate of Industrial Electrical Equipment, Machine Tool Control.

The main purpose of the Order is to ensure that electrical equipment, the manufacture of which absorbs scarce materials and labour, is used to best advantage to meet essential requirements. The control is applied in a manner suited to the normal procedure of the electrical industry, and with a minimum of formality in regard to supplies of equipment for essential purposes.

To avoid duplication of control the Board of Trade Machinery, Plant and Appliances (Control) (No. 3) Order, 1942, will no longer apply to industrial electrical equipment.

The Order relates to electric motors, generators, and other rotary electrical machinery, and control gear up to 1,000 k.v.a., kw. or h.p., switchgear over 60 amps. capacity for use on circuits up to 650 volts, and static condensers for power factor correction. The Order permits the acquisition or disposal of certain electrical equipment to Government departments, public-utility undertakings and firms engaged on essential work, without licence in specified circumstances. It makes provision for the acquisition of equipment temporarily in an emergency and for the use of certain used equipment where only a small amount of labour and materials would be required for reconditioning.

Applications for permission to acquire industrial electrical equipment for any purpose requiring a licence must be made to the Directorate of Industrial Electrical Equipment, Machine Tool Control, 35, Old Queen Street, London, S.W.1.

Copies of the Order, the Control of Industrial Electrical Equipment (No. 1) Order, 1943, which came into force on April 19, 1943, may be obtained from H.M. Stationery Office, York House, Kingsway, W.C.2, or through any bookseller.

OBITUARY

MR. AMOS ENGLAND, chief chemist of the Blythe Colour Works, Limited, enamel manufacturers, Stoke-on-Trent, died recently.

MR. DAVID GRANT BLACKIE, of David Grant & Company, gas meter manufacturers and brassfounders, died suddenly at his home in Edinburgh.

MR. ALFRED DAVIES, joint managing director of English Clays Lovering Pochin & Company, Limited, died recently. He was also a director of the Charlestown Engineering Company, Limited, and other concerns.

MR. JOHN WILLETTS RYAN, who was for many years a director of Clayton & Shuttleworth, Limited, agricultural engineers, of Lincoln, and later associated with Kryn & Lahy (1928), Limited, engineers, steelfounders, etc., of Letchworth, died suddenly early this month.

NEWS IN BRIEF

WHOLESALE PRICES in March, as measured by the Board of Trade index number, showed a rise of 0.1 per cent. compared with February.

UNIONS AND EMPLOYERS in the light-castings industry have reached agreement increasing the basic rate for labourers by 3s. a week as from April 9.

AVELING-BARFORD, LIMITED, manufacturers of power-driven rollers, etc., have increased their capital by £275,000 to £650,000 by the creation of 75,000 £1 cumulative preference and 800,000 5s. ordinary shares.

THE GROSS VALUE of United States manufactured products in 1942 was $121,000,000,000, according to latest Commerce Department estimates. This compares with $57,000,000,000 reported for 1939 and with $94,000,000,000 for 1941.

THE BRUSH BERYLLIUM COMPANY has started a $600,000 addition to its plant in Lorain. Greatly increased output of beryllium at this plant, it is expected, will make the Cleveland-Lorain area the leader in this field of metal production in the United States.

THE U.S. WAR PRODUCTION BOARD has authorised an increase of about 30 per cent. in steel tonnage for farm machinery manufacture in the first quarter of this year. This will amount to 50,000 tons and raises the first quarter volume to 187,000 tons, subsequent to an increase from 120,000 to 187,000 tons for the fourth quarter of 1942.

IN HIS ANNUAL REPORT, Mr. Arthur Fair, secretary of the General Ironfitters' Association of Scotland predicts that there will be an abundance of work in the light-castings industry after the war. He believes that many firms now on war production who never before manufactured light castings will be seeking new industrial fields for their factories to meet the vast demand for housing materials.

THE QUESTION OF non-union labour in the iron-foundry trade is dealt with by Mr. Hugh Murdoch, secretary of the Iron Founding Workers' Association, in his annual report. The Association suggest that an addition to or alteration of the Defence Regulations (under which strike action is illegal) should be made to safeguard the interests of trade union members. The Minister of Labour has been approached on the matter and it is understood that he has referred the correspondence to the Chief Industrial Commissioner for Scotland.

RANGE BOILER MAKERS

The Range Boiler Makers' Association, Limited, has been registered as a company limited by guarantee without share capital. Mr. R. W. Jenkins is the chairman and the Council is to be nominated by T. Balmforth & Company, Limited, Brinton Bros., Canal Boiler Works, Limited, Dartmouth Manufacturing Company, Limited, East London Engineering Works, Limited, Robt. Jenkins & Company, Limited, Mitchell, Russell & Company, Limited, Rother Boiler Company, Limited, A. Stevenson & Company, Limited, and Tees Electric Welding Company.

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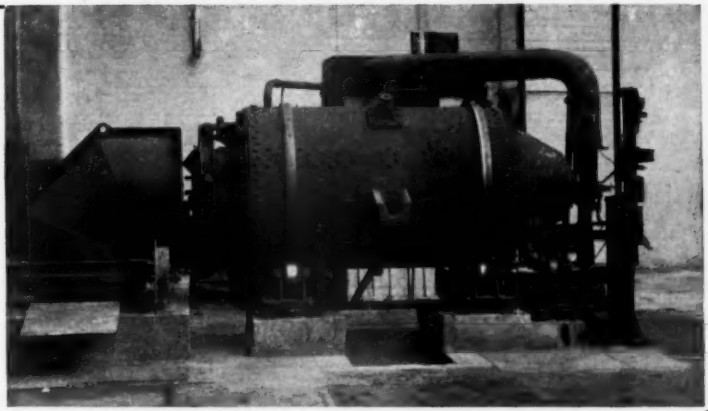

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